WHAT IS CLAIMED:

1. A synthetic polynucleotide comprising a DNA sequence encoding an HCV protein selected from the group consisting of HCV core protein, HCV E1 protein, HCV E1+E2 protein, HCV NS5a protein, HCV NS5b protein and fragments thereof, the DNA sequence comprising codons optimized for expression in a vertebrate host.

2. A plasmid vector comprising the polynucleotide of Claim 1, the plasmid vector being suitable for immunization of a vertebrate host.

3. The polynucleotide of Claim 1 which is HCV genotype I/Ia core.

4. The polynucleotide of Claim 1 having the sequence

ATGAGCACcA AcCCcAAgCC cCAgAGgAAg ACCAAgaGgA ACACCAACaG gaGgCCcCAG
GAtGTgAAGT TCCCtGGgGG aGGcCAGATt GTgGGaGGgG TcTACcTGcT GCCcaGgAGG
GGCCCCAGGc TGGGgGTGaG gGCtACcaGG AAGACcTCtG AGaGGTCcCA gCCcaGgGGc
AGGaGgCAGC CcATCCCCAA GGCcaGgaGG CCtGAGGGCc GcTCCTGGGC cCAGCCtGGc
TACCCcTGGC CCCTgTATGG CAATGAaGGC TTtGGcTGGG CtGGcTGGCT gCTGTCCCCC
aGgGGCTCca GGCCctccTG GGGCCCCACa GACCCCaGGa GgaGGTCcaG gAAccTGGGc
AAGGTgATtG AcACCCTgAC cTGtGGCTTt GCtGACCTgA TGGGcTACAT CCCcCTgGTg
GGgGCtCCtG TgGGaGGgGT gGCtAGGGCt CTGGCtCATG GgGTgAGGGT gCTGGAGGAt
GGGGTGAACT ATGCtACtGG cAAccTGCCt GGcTGCTCcT TCTCcATCTT CCTgCTGGCc
CTGCTcTCCT GCCTGACaGT gCCtGCTTCT GCc

5. The plasmid vector of Claim 2 having the sequence

GATATTGGCT ATTGGCCATT GCATACGTTG TATCCATATC ATAATATGTA CATTTATATT
GGCTCATGTC CAACATTACC GCCATGTTGA CATTGATTAT TGACTAGTTA TTAATAGTAA
TCAATTACGG GGTCATTAGT TCATAGCCCA TATATGGAGT TCCGCGTTAC ATAACTTACG
GTAAATGGCC CGCCTGGCTG ACCGCCCAAC GACCCCCGCC CATTGACGTC AATAATGACG
TATGTTCCCA TAGTAACGCC AATAGGGACT TTCCATTGAC GTCAATGGGT GGAGTATTTA
CGGTAAACTG CCCACTTGGC AGTACATCAA GTGTATCATA TGCCAAGTAC GCCCCCTATT
GACGTCAATG ACGGTAAATG GCCCGCCTGG CATTATGCCC AGTACATGAC CTTATGGGAC
TTTCCTACTT GGCAGTACAT CTACGTATTA GTCATCGCTA TTACCATGGT GATGCGGTTT
TGGCAGTACA TCAATGGGCG TGGATAGCGG TTTGACTCAC GGGGATTTCC AAGTCTCCAC
CCCATTGACG TCAATGGGAG TTTGTTTTGG CACCAAAATC AACGGGACTT TCCAAAATGT
CGTAACAACT CCGCCCCATT GACGCAAATG GGCGGTAGGC GTGTACGGTG GGAGGTCTAT
ATAAGCAGAG CTCGTTTAGT GAACCGTCAG ATCGCCTGGA GACGCCATCC ACGCTGTTTT
GACCTCCATA GAAGACACCG GGACCGATCC AGCCTCCGCG GCCGGGAACG GTGCATTGGA
ACGCGGATTC CCCGTGCCAA GAGTGACGTA AGTACCGCCT ATAGAGTCTA TAGGCCCACC

CCCTTGGCTT CTTATGCATG CTATACTGTT TTTGGCTTGG GGTCTATACA CCCCCGCTTC
CTCATGTTAT AGGTGATGGT ATAGCTTAGC CTATAGGTGT GGGTTATTGA CCATTATTGA
CCACTCCCCT ATTGGTGACG ATACTTTCCA TTACTAATCC ATAACATGGC TCTTTGCCAC
AACTCTCTTT ATTGGCTATA TGCCAATACA CTGTCCTTCA GAGACTGACA CGGACTCTGT
ATTTTTACAG GATGGGGTCT CATTTATTAT TTACAAATTC ACATATACAA CACCACCGTC
CCCAGTGCCC GCAGTTTTTA TTAAACATAA CGTGGGATCT CCACGCGAAT CTCGGGTACG
TGTTCCGGAC ATGGGCTCTT CTCCGGTAGC GGCGGAGCTT CTACATCCGA GCCCTGCTCC
CATGCCTCCA GCGACTCATG GTCGCTCGGC AGCTCCTTGC TCCTAACAGT GGAGGCCAGA
CTTAGGCACA GCACGATGCC CACCACCACC AGTGTGCCGC ACAAGGCCGT GGCGGTAGGG
TATGTGTCTG AAAATGAGCT CGGGGAGCGG GCTTGCACCG CTGACGCATT TGGAAGACTT
AAGGCAGCGG CAGAAGAAGA TGCAGGCAGC TGAGTTGTTG TGTTCTGATA AGAGTCAGAG
GTAACTCCCG TTGCGGTGCT GTTAACGGTG GAGGGCAGTG TAGTCTGAGC AGTACTCGTT
GCTGCCGCGC GCGCCACCAG ACATAATAGC TGACAGACTA ACAGACTGTT CCTTTCCATG
GGTCTTTTCT GCAGTCACCG TCCTTAgatc taccATGAGC ACCAACCCCA AGCCCCAGAG
GAAGACCAAG AGGAACACCA ACAGGAGGCC CCAGGATGTG AAGTTCCCTG GGGGAGGCCA
GATTGTGGGA GGGGTCTACC TGCTGCCCAG GAGGGGCCCC AGGCTGGGGG TGAGGGCTAC
CAGGAAGACC TCTGAGAGGT CCCAGCCCAG GGGCAGGAGG CAGCCCATCC CCAAGGCCAG
GAGGCCTGAG GGCCGCTCCT GGGCCCAGCC TGGCTACCCC TGGCCCCTGT ATGGCAATGA
AGGCTTTGGC TGGGCTGGCT GGCTGCTGTC CCCCAGGGGC TCCAGGCCCT CCTGGGGCCC
CACAGACCCC AGGAGGAGGT CCAGGAACCT GGGCAAGGTG ATTGACACCC TGACCTGTGG
CTTTGCTGAC CTGATGGGCT ACATCCCCCT GGTGGGGGCT CCTGTGGGAG GGGTGGCTAG
GGCTCTGGCT CATGGGGTGA GGGTGCTGGA GGATGGGGTG AACTATGCTA CTGGCAACCT
GCCTGGCTGC TCCTTCTCCA TCTTCCTGCT GGCCCTGCTC TCCTGCCTGA CAGTGCCTGC
TTCTGCCgaa ttcgcttcca atgagaacat ggagaccatg aaccagccct accacatctg
ccgcggcttc acctgcttca agaagtaaac ccgggaattc taaagtcgaC AGCGGCCGCG
ATCTGCTGTG CCTTCTAGTT GCCAGCCATC TGTTGTTTGC CCCTCCCCCG TGCCTTCCTT
GACCCTGGAA GGTGCCACTC CCACTGTCCT TTCCTAATAA AATGAGGAAA TTGCATCGCA
TTGTCTGAGT AGGTGTCATT CTATTCTGGG GGGTGGGGTG GGGCAGCACA GCAAGGGGGA
GGATTGGGAA GACAATAGCA GGCATGCTGG GGATGCGGTG GGCTCTATGG GTACGGCCGC
AGCGGCCTTA ATTAAGGCCG CAGCGGCCGT ACCCAGGTGC TGAAGAATTG ACCCGGTTCC
TCGACCCGTA AAAAGGCCGC GTTGCTGGCG TTTTTCCATA GGCTCCGCCC CCCTGACGAG
CATCACAAAA ATCGACGCTC AAGTCAGAGG TGGCGAAACC CGACAGGACT ATAAAGATAC
CAGGCGTTTC CCCCTGGAAG CTCCCTCGTG CGCTCTCCTG TTCCGACCCT GCCGCTTACC
GGATACCTGT CCGCCTTTCT CCCTTCGGGA AGCGTGGCGC TTTCTCAATG CTCACGCTGT
AGGTATCTCA GTTCGGTGTA GGTCGTTCGC TCCAAGCTGG GCTGTGTGCA CGAACCCCCC
GTTCAGCCCG ACCGCTGCGC CTTATCCGGT AACTATCGTC TTGAGTCCAA CCCGGTAAGA
CACGACTTAT CGCCACTGGC AGCAGCCACT GGTAACAGGA TTAGCAGAGC GAGGTATGTA
GGCGGTGCTA CAGAGTTCTT GAAGTGGTGG CCTAACTACG GCTACACTAG AAGGACAGTA
TTTGGTATCT GCGCTCTGCT GAAGCCAGTT ACCTTCGGAA AAAGAGTTGG TAGCTCTTGA
TCCGGCAAAC AAACCACCGC TGGTAGCGGT GGTTTTTTTG TTTGCAAGCA GCAGATTACG
CGCAGAAAAA AAGGATCTCA AGAAGATCCT TTGATCTTTT CTACGTGATC CCGTAATGCT
CTGCCAGTGT TACAACCAAT TAACCAATTC TGATTAGAAA AACTCATCGA GCATCAAATG
AAACTGCAAT TTATTCATAT CAGGATTATC AATACCATAT TTTTGAAAAA GCCGTTTCTG
TAATGAAGGA GAAAACTCAC CGAGGCAGTT CCATAGGATG GCAAGATCCT GGTATCGGTC
TGCGATTCCG ACTCGTCCAA CATCAATACA ACCTATTAAT TTCCCCTCGT CAAAAATAAG
GTTATCAAGT GAGAAATCAC CATGAGTGAC GACTGAATCC GGTGAGAATG GCAAAAGCTT
ATGCATTTCT TTCCAGACTT GTTCAACAGG CCAGCCATTA CGCTCGTCAT CAAAATCACT
CGCATCAACC AAACCGTTAT TCATTCGTGA TTGCGCCTGA GCGAGACGAA ATACGCGATC
GCTGTTAAAA GGACAATTAC AAACAGGAAT CGAATGCAAC CGGCGCAGGA ACACTGCCAG
CGCATCAACA ATATTTTCAC CTGAATCAGG ATATTCTTCT AATACCTGGA ATGCTGTTTT
CCCGGGGATC GCAGTGGTGA GTAACCATGC ATCATCAGGA GTACGGATAA AATGCTTGAT
GGTCGGAAGA GGCATAAATT CCGTCAGCCA GTTTAGTCTG ACCATCTCAT CTGTAACATC
ATTGGCAACG CTACCTTTGC CATGTTTCAG AAACAACTCT GGCGCATCGG GCTTCCCATA
CAATCGATAG ATTGTCGCAC CTGATTGCCC GACATTATCG CGAGCCCATT TATACCCATA
TAAATCAGCA TCCATGTTGG AATTTAATCG CGGCCTCGAG CAAGACGTTT CCCGTTGAAT

ATGGCTCATA ACACCCCTTG TATTACTGTT TATGTAAGCA GACAGTTTTA TTGTTCATGA
TGATATATTT TTATCTTGTG CAATGTAACA TCAGAGATTT TGAGACACAA CGTGGCTTTC
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6. The polynucleotide of Claim 4 from which the PAb sequence has been removed.

7. The plasmid vector of Claim 5 from which the PAb sequence has been removed.

8. A method for inducing immune responses in a vertebrate against HCV epitopes which comprises introducing between 1 ng and 100 mg of the polynucleotide of Claim 1 into the tissue of the vertebrate.

9. A method for inducing immune responses against infection or disease caused by HCV which comprises introducing into the tissue of a vertebrate the polynucleotide of Claim 1.

10. A vaccine for inducing immune responses against HCV infection which comprises the polynucleotide of Claim 1 and a pharmaceutically acceptable carrier.

11. A method for inducing anti-HCV immune responses in a primate which comprises introducing the polynucleotide of Claim 1 into the tissue of said primate and concurrently administering interleukin-12 parenterally.

12. A method of inducing an antigen presenting cell to stimulate cytotoxic and helper T-cell proliferation an effector functions including lymphokine secretion specific to HCV antigens which comprises exposing cells of a vertebrate in vivo to the polynucleotide of Claim 1.

13. A method of treating a patient in need of such treatment comprising administering to the patient the polynucleotide of Claim 1 in combination with interferon-alpha, Ribavirin, Zidovudine, or other pharmaceutically acceptable antiviral agents..

14. A pharmaceutical composition comprising the polynucleotide of Claim 1.

15. A method of inducing an immune response comprising administering the polynucleotide of Claim 1 to a patient, the administration of the polynucleotide antedating or coinciding or following administration to the patient of a subunit, recombinant, recombinant live vector, inactivated, recombinant inactivated vector, or live attenuated HCV vaccine.

16. A method for inducing immune responses in a vertebrate against HCV epitopes which comprises introducing between 1 ng and 100 mg of the polynucleotide of Claim 2 into the tissue of the vertebrate.

17. A method for inducing immune responses against infection or disease caused by HCV which comprises introducing into the tissue of a vertebrate the polynucleotide of Claim 2.

18. A vaccine for inducing immune responses against HCV infection which comprises the polynucleotide of Claim 2 and a pharmaceutically acceptable carrier.

19. A method for inducing anti-HCV immune responses in a primate which comprises introducing the polynucleotide of Claim 2 into the tissue of said primate and concurrently administering interleukin 12 parenterally.

20. A method of inducing an antigen presenting cell to stimulate cytotoxic and helper T-cell proliferation an effector functions including lymphokine secretion specific to HCV antigens which comprises exposing cells of a vertebrate in vivo to the polynucleotide of Claim 2.

21. A method of treating a patient in need of such treatment comprising administering to the patient the polynucleotide of Claim 2 in combination with interferon-alpha, Ribavirin, Zidovudine, or other pharmaceutically acceptable antiviral agents..

22. A pharmaceutical composition comprising the polynucleotide of Claim 2.

23. A method of inducing an immune response comprising administering the polynucleotide of Claim 2 to a patient, the administration of the polynucleotide antedating or coinciding or following administration to the patient of a subunit, recombinant, recombinant live vector, inactivated, recombinant inactivated vector, or live attenuated HCV vaccine.

24. The vector of Claim 2 which is selected from V1Ra.HCV1CorePAb, Vtpa.HCV1CorePAb, VUb.HCV1CorePAb, V1Ra.HCV1Core, Vtpa.HCV1Core and VUb.HCV1Core.

25. A pharmaceutical composition comprising the vector of Claim 21.

26. The DNA sequence of Claim 1 selected from the group consisting of a nucleotide sequence shown in Figure 5, Figure 9, Figure 10, Figure 11, Figure 12 and Figure 13.